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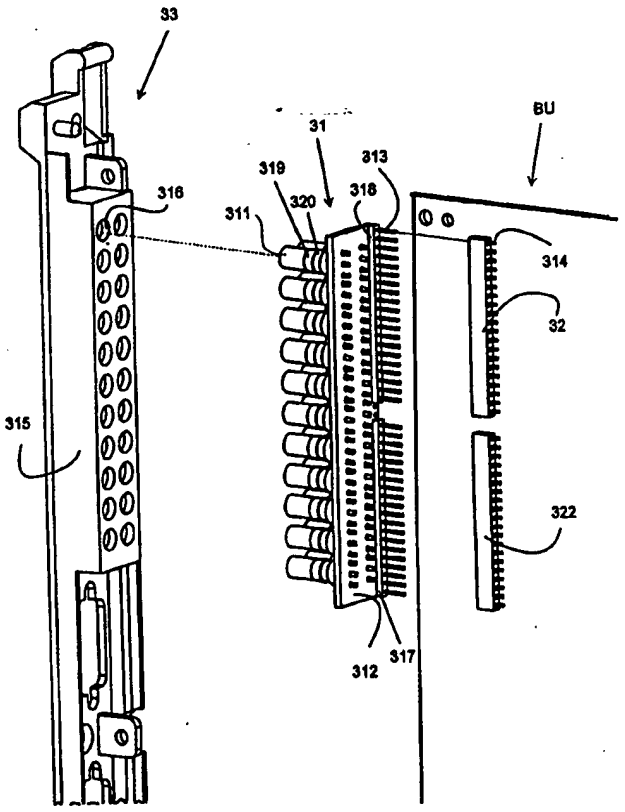
(54) Title: COAXIAL INTERFACE FOR A PLUG–IN UNIT

(57) Abstract

The interface arrangement for implementing a connection between coaxial connectors (316) and a board unit (BU) is based on the insight that coaxial connectors taking much space are taken away fromthe plug–in unit's card and a connection is made which can be connected easily between connectors and card and which can be easily removed when the front panel is removed. This is brought about by using a special auxiliary circuit board (312), to which the coaxial connectors are attached. From each connector extends a wire path on the circuit board to a connector bar, which is soldered to the circuit board edge and from which connector pins (313) protrude outwards. On the board unit (BU) of the plug–in unit, a connector bar (32, 322) is soldered, which contains counter connectors for the connectors of the auxiliary circuit board. The connectors of this connector bar are connected with such wire paths located on the board unit (BU) which convey signals to integrated circuits mounted on the circuit board. When the front panel is removed from the plug–in unit by pulling it in the direction of the plug–in unit's surface, the auxiliay circuit board attached to the front panel will follow together with its coaxial connectors and the connector pins (313) of the connector bar will leave their counter connectors which are attached to the board unit (BU) of the plug–in unit. Correspondingly, when the front panel is mounted, the connector pins will be pushed into their counter connectors and an electric connection will result.



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Coaxial interface for a plug-in unit

Field of the invention

This invention concerns an interface with which signals brought from several separate coaxial cables to standard coaxial connectors are conducted to a printed circuit board. The invention is especially concerned with bringing such 2 Mbit/s signals to the plug-in unit board which are brought to the plug-in unit through cables.

Background of the invention

The physical components of a telecommunications system are built by using special sub-racks, in which printed circuit boards, connectors, plug-in units, power supply units, fans etc are located. Locating may take place at the plant before the final place of installation, whereby the furnished sub-rack forms a complete telecommunications module, which can be tested. The sub-rack is constructed so that each side of its front part is provided with flanges in parallel with the surface level of the front part, and the flanges are provided with holes. The sub-rack width without flanges is standardised, so owing to standard width and dimensions, equipment made by different manufacturers can be placed in the same sub-rack.

For the sub-racks, special racks are constructed to which the sub-racks are attached. By way of simplified description, the rack comprises two vertical mounting rails, which have holes and which are at a standard distance from each other. In practice, the rack is part of an equipment cabinet wherein several sub-racks can be located on top of each other.

In the equipment cabinet 1 shown in Figure 1 numbers 2, 3, 4 and 5 refer to different sub-racks mounted on mounting rails 7 and 8 located on the sides of the equipment cabinet. The sub-rack can be supported in the cabinet only at its side flanges or a shelf may be made for it on which the sub-rack is placed. An especially heavy component, such as batteries 6, may be placed on the bottom of the cabinet.

Plug-in units or BU (Board Units) are located in such a cabinet as shown in Figure 2. In the sub-rack constructed for plug-in units there are located in the back part a vertical back panel or circuit board 10, in which those electric circuits and internal circuit groups are formed through which card units are connected to that piece of telecommunications equipment to

which the sub-rack belongs. In the back panel 10 there is at each card site a BPC (Back Panel Connector), to which the cards are connected with their own back connectors BC. Through the back connectors BC and back panel connectors BPC the cards are connected e.g. to the internal bus of a multiplexer unit formed on the sub-rack's back panel. The front edge of the card unit may have a front panel, which is not shown in Figure 2 and at which the unit may be attached mechanically to the sub-rack and to which connectors may also be attached. The front panel also serves as an EMC (Electro Magnetic Compatibility) protector between the card and the environment.

Plug-in units are used e.g. in multiplexers, where a cable transferring a high-rate e.g. 2 Mbit/s signal is brought to the card. In the card low-rate 64 kbit/s channels are separated from the signal, they are processed along with channels of other cards in other units and 32 PCM channels are multiplexed into a 2 Mbit/s signal which is again forwarded from the card.

Incoming and outgoing coaxial cables can be connected in many ways to the plug-in unit. It is possible e.g. to use an intermediate structure mounted to the front edge of the circuit board. Such a solution is presented in US patent 3 676 746. It uses a metal profile with a [-shaped cross-section and bent into right-angled U-shape. The profile is riveted to the circuit board at its edges. Multiple-pole connectors are attached to the profile and they pass through the bottom part profile of the U-shape, whereby the connector end at the front side of the profile will receive the cable and peaks located at the connector end at the back side are soldered to holes in an insulating board. The insulating board, which is located at right angles to the circuit board and is soldered to this, has wires, which at one end are soldered to connector peaks in the holes of the board and at their other ends to the circuit board 9. The resulting structure is rigid, uniform and not removable.

One way is to locate an FC (Front Connector) at the front edge of the card, such as an RF angle connector according to the standard, to which a socket-like RF connector according to the DIN 41626/2 standard at the end of the coaxial cable is connected. The connectors are generally known as SMB connectors and the connection implements a 2 Mbit/s connection. Several angle connectors may be placed in parallel in a row at the card's front edge, as is shown in Figure 2, whereby one coaxial cable can be

connected to each connector. There are even two-layer angle connectors for mounting to a circuit card, so two connector rows can be formed on top of each other. This of course makes it possible to increase the number of cables which can be connected to the card. Other connectors than coaxial connectors may also be used as front connectors, as is illustrated by reference numbers 21 and 22. These connectors can be used e.g. for connecting optical cables and for connecting low-frequency signals etc.

A third way of connecting coaxial cables to a plug-in unit is to make the back panel higher than the sub-rack and to locate RF connectors in the back panel part protruding from the sub-rack. Hereby coaxial cables are brought between two sub-racks to the back part of the sub-rack and SMB connectors at the cable ends are pushed into coaxial connectors in the back panel.

A fourth way is to leave in one side of the sub-rack a vacant space, in which no plug-in units are located. However, the back panel extends into this space and all necessary coaxial and other connectors are located at this place of the back panel.

These known ways of connecting coaxial cables to a plug-in unit suffer from some drawbacks which become more obvious with a growing packing density of plug-in units. The performance of telecommunications equipment is growing constantly while the equipment is becoming smaller. Since more and more signals must be supplied to and taken from one plug-in unit, it has become an unavoidable problem how to place a great number of coaxial connectors in the small area of the plug-in unit's card. Many coaxial connectors on a circuit card take space from other components and, in addition, it is difficult to control many connectors. On the other hand, with increasing efficiency of the plug-in unit and with the associated need for more connections such a situation may arise that there simply is not any space on the circuit card for placing the required number of coaxial connectors, so due to the connectors the plug-in unit must be divided into two units. Another drawback is growing interference, because when the connector is located far from the circuit board edge, the coaxial line must be brought above the circuit board for some distance before the signal is taken "down" to the circuit board level.

When RF angle connectors according to the standard are used as front connectors at the front edge of the plug-in unit, such a situation will

arise where the number of connectors is not sufficient, even though there are connectors over the whole width of the front edge and even in two separate layers. When there are tens of separate connectors, into each of which a cable terminated with an SMB connector is pushed separately, it will take much time to exchange a faulty plug-in unit, since each cable must first be removed separately and after the exchange of card unit it must again be connected separately to the angle connector.

If a front panel is used in the plug-in unit, whereby the front panels of adjacent plug-in units form a uniform EMC protector, openings must be made in the front panel through which cables are drawn to SMB connectors in the circuit card. Of course, it is not hereby possible to remove SMB connectors along with the front panel, but the cables must first be removed from the connectors and only then can the front panel be removed.

It is also a problem if the connectors are in the back panel, as each cable must then be drawn manually between sub-racks to the back panel and connected there to a connector in the back panel. It is a narrow space to work in.

This invention aims at an arrangement which does not have the drawbacks of the known arrangements presented above. The arrangement ought to allow the use of a great number of connectors per plug-in unit without increasing interference or taking surface area from the circuit card. It is an important objective to be entirely rid of coaxial connectors mounted on the circuit card.

The established objectives are achieved with a coaxial interface for a plug-in unit as defined in the independent claims.

Brief summary of the invention

The proposed coaxial interface is based on the insight that coaxial connectors taking up much space are removed from the card of the plug-in unit, they are located in the front panel of the card unit and a connection is made between connectors and card which can be easily connected and easily removed when the front panel is removed. This is made by using a special auxiliary circuit board, to which the coaxial connectors are attached. On the circuit board a wire path extends from each connector to a connector bar soldered to the circuit board edge and having connector peaks protruding outwards. The auxiliary circuit board is attached to the front panel

of the plug-in unit. An insulating board, coaxial connectors, connector pins and wire paths form a comprehensive unit which can be mounted to the circuit board in parallel with its surface and which can be removed from the circuit board.

To the circuit board of the plug-in unit a connector bar is soldered having counter connectors for the connectors of the auxiliary circuit board. The connectors of this connector bar are connected with the wire paths in the circuit board which convey signals to integrated circuits mounted on the circuit board. When the front panel is removed by pulling it out of the plug-in unit in parallel with its surface, the auxiliary board attached to the front panel together with its coaxial connectors will follow and the connector pins of the connector bar will leave their counter connectors attached to the circuit board of the plug-in unit. Correspondingly, when attaching the front panel, the connector pins will be pushed into their counter connectors in parallel with the plug-in unit's surface and an electric connection will result.

In the interface according to the invention a great number of coaxial connectors may be located on the auxiliary circuit board in several rows, and despite the great number of connectors only a minimum surface area is taken from the circuit board of the plug-in unit. In addition, no high-frequency signals causing interference need be conveyed above the circuit board surface, but they are conducted to the circuit board and away from this at the board edge.

Brief description of the drawings

The invention will be described more closely referring to the attached diagrammatic drawings, wherein

Figure 1 shows an equipment cabinet where sub-racks are mounted;
Figure 2 shows a plug-in unit;
Figure 3 is an exploded view of an interface according to the invention;
Figure 4 shows the interface assembled;
Figure 5a is a perspective view of the removable entity;
Figure 5b is a side view of the removable entity;
Figure 5c is an end view of the removable entity; and
Figure 6 is another exploded view of the interface according to the invention.

Description of the preferred embodiment

Figure 3 is an exploded view of the basic components of the interface according to the invention. They comprise an entity 31 removable from the board unit BU of the plug-in unit and one or several pin head connectors 32, 322 attached to board unit BU of the plug-in unit.

Insulator 312 is a basic part of the removable entity 31. On its one side a set of standard SMB coaxial connectors is attached by soldering, of which only one is referred to with reference number 311 for the sake of clarity. On the opposite side of the circuit board 312 edge one or several connector bars 317, 318 are soldered, from which connector pins protrude at right angles away from the circuit board's surface. For the sake of clarity only one connector peak is indicated by reference number 313. There are wires (not shown) in the insulator board connecting the signal pole of each coaxial connector with one connector pin in the connector bar. Thus, the signal peak of each coaxial connector is connected with one connector pin, so one connector pin corresponds to one coaxial connector. There are also connector pins for earth purposes in the connector bar.

It is preferable to use a circuit board as insulator board, whereby wires can easily be implemented as strip lines. The connector bar is a commercially available component which is generally used.

In the pin head connector 32, 322 attached to the board unit BU of the plug-in unit with surface-mounting technique there are such adjacent openings in the side facing towards the board unit edge, the spacing of which is similar to the spacing of connector bar peaks 313 in the board of the removable entity 31. There are contact pins in the openings which are in electric connection with surface-mounted contacts located on the opposite side of the pin head connector, only one of which is indicated by reference number 314. When the pin head connectors are soldered to the board unit BU of the plug-in unit, each contact 314 will come into contact with the wire path (not shown) located at that point of the board. The openings together with their contact pins function as counter connectors for the connector pins 313 of the removable entity 31. The pin head connector is a commercially available component in general use and it comes both as a surface-mounted model like the connector shown in the figure and as a peak model.

The function of the structure is shown by Figure 3. The removable entity 31 is mounted on board unit BU of the plug-in unit simply so that its

pins 313 are pushed into counter connectors in the pin head connector located on board unit BU. The structure is made firm by the plug-in unit's front panel 33, wherein an opening 316 is made for each coaxial connector 311. When the front panel is attached to the plug-in unit, each connector is pushed into its own opening and it is supported in the lateral direction against the periphery of the opening. It is advantageous to use such a coaxial connector model which has a compressible ring 319. The ring is placed at the periphery of the opening where it is slightly compressed and it will move to the other side of the opening. The periphery of the opening will hereby enter groove 320 in the connector (Figure 5c), and in this way the connector will stay firmly in position without being able to move in the longitudinal direction. The metal front panel also functions to earth the coaxial connectors. When required, a depression 315 may be made in the front panel with openings 316 in its bottom. This depression is especially advantageous when using a holder for a coaxial connector as described in Finnish Patent Application No. 970291 filed at the same time as the present application. This holder collects the coaxial cables, having a counter connector for connectors 311 at their ends, into an entity which is easily handled.

When the removable entity has been attached to the front panel, the result is a comprehensive package, which may be attached to and removed from the plug-in unit. When removing the front panel, the coaxial connectors will follow the front panel automatically. This structure is the most advantageous one in practice, and therefore the term "removable entity" also contains the front panel in practice.

One considerable advantage which can be achieved with the structure is that when a signal is brought from insulator board 312 to the circuit card of the plug-in unit, the connection height is less than one millimetre. Such a low height is not achieved in any known manner. This is of great significance from the viewpoint of interference.

Figure 4 shows the final result in an assembled state. Front panel 33, insulator board 312 and board unit BU form a rigid whole which is nevertheless easily disassembled.

Figures 5a - 5c show a removable entity 31 of bigger size. The grouping of coaxial connectors on the surface of board unit 312 can be clearly seen in Figure 5a. Coaxial connectors are here in two rows, but they

might as well be arranged in three or more rows by making the insulator board wider. The maximum height H of the insulator board may be almost equal to the height of the plug-in unit's front panel, whereby a really great number of coaxial interfaces are obtained for one plug-in unit, however, without taking space from the circuit card of the card unit. The occupied surface area is only a narrow strip on the card's front edge.

It can be seen both in Figure 5a and in Figure 5b that peaks 313 of the connector bar penetrate the insulator board. This makes it easier to solder the connector bar, but it is not necessary, if a surface-mounted model is used as connector bar.

Figure 5c, which is an end view of the removable entity, shows those central wires 321 of the coaxial connectors which extend through insulator board 5c. In the soldering process they are connected with strip lines on the insulator board surface and through these with peaks 313 on connector bar 318.

Figure 6 finally is an exploded view of the interface arrangement according to the invention. When the removable entity is attached to the front panel, the result is a comprehensive package, which may be attached to and removed from the plug-in unit. This structure is the most advantageous one in practice and, for this reason, the term "removable entity" also contains the front panel 33. When the front panel is removed from the plug-in unit, the circuit board attached to the front panel will follow along with its coaxial connectors and the connector pins of the connector bar will leave their counter connectors 32, 322 mounted on the circuit board of the plug-in unit. Correspondingly, when mounting the front panel the connector pins will be pushed into their counter connectors and an electric connection will result.

Claims

1. Interface arrangement for bringing about a removable connection between coaxial connectors and a circuit board, the arrangement comprising an insulator board, coaxial connectors mounted on one surface of the insulator board so that their central axis is at right angles against the surface of the insulator board, and wires located in such a way on the insulator board that each wire is part of the electric connection between the circuit board and one of the coaxial connectors, c h a r a c t e r i z e d in that

connector pins (313) are located on the opposite surface of the insulator board in such a way that they form close to the insulator board edge a row parallel with said edge , in which the connector pins are at right angles against the insulator board surface and each connector pin is connected with a coaxial connector by a wire located on the insulator board,

whereby the insulator board (312), coaxial cables (311), connector pins (313) and wires form a comprehensive entity which can be mounted to and removed from the circuit board,

such counter connectors (32, 322) for the connector pins are located in a row on the board unit (BU) to which connection is made through a motion in parallel with the board unit surface,

the connector pins (313) are connected with their counter connectors by pushing the insulator board with a pushing motion in parallel with the board unit (BU) surface, whereby an electrically conductive connection is formed between the coaxial connector and the counter connector, and when the insulator board is pulled in the direction of the board unit surface the connector pins will leave their counter connectors.

2. Interface arrangement as defined in claim 1,

c h a r a c t e r i z e d in that the insulator board (312) is a circuit board and the wires are formed directly in the circuit board.

3. Interface arrangement as defined in claim 1,

c h a r a c t e r i z e d in that the connector pins (313) belong to a bar connector which is known as such and which is mounted on the insulator board.

4. Interface arrangement as defined in claim 1, characterized in that the counter connectors for connector pins belong to a pin head connector, which is known as such and which is mounted on the circuit board.

5. Interface arrangement as defined in claim 1, characterized in that the circuit board is the circuit card of the plug-in unit (BU).

6. Interface arrangement as defined in claim 1, characterized in that it also comprises a plug-in unit front panel (33), wherein openings (316) have been made, whereby when the front panel is attached to the sub-rack, each coaxial connector will be placed in its own opening and will be supported in this.

7. Interface arrangement as defined in claim 6, characterized in that the coaxial connectors are locked in their openings, whereby the front panel and the removable entity form a comprehensive body, which can be mounted to and removed from the plug-in unit.

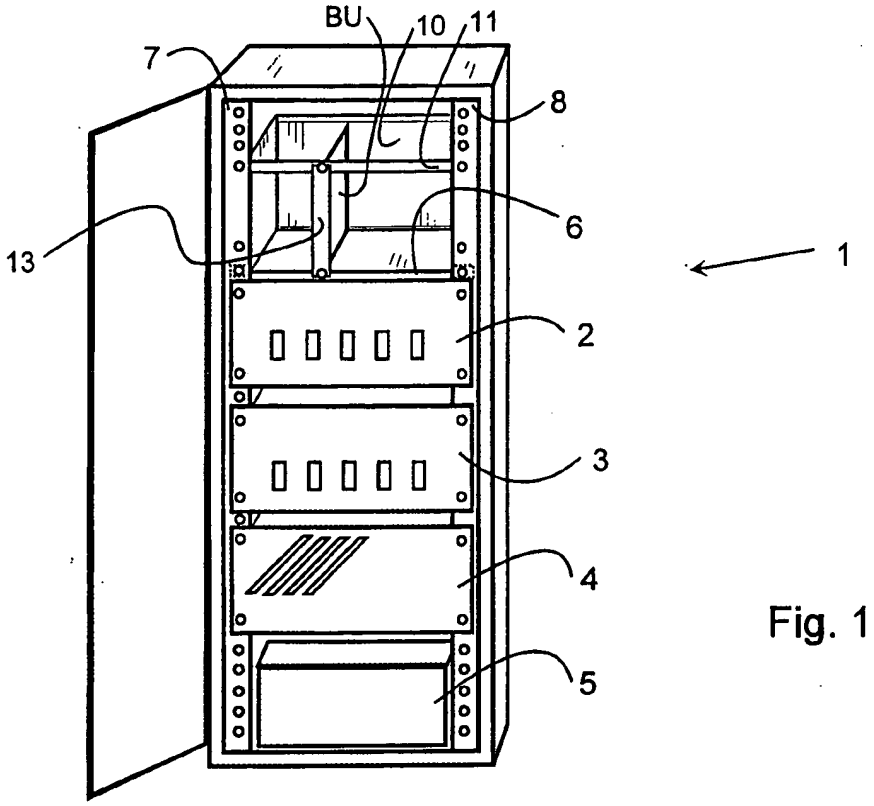

Fig. 1

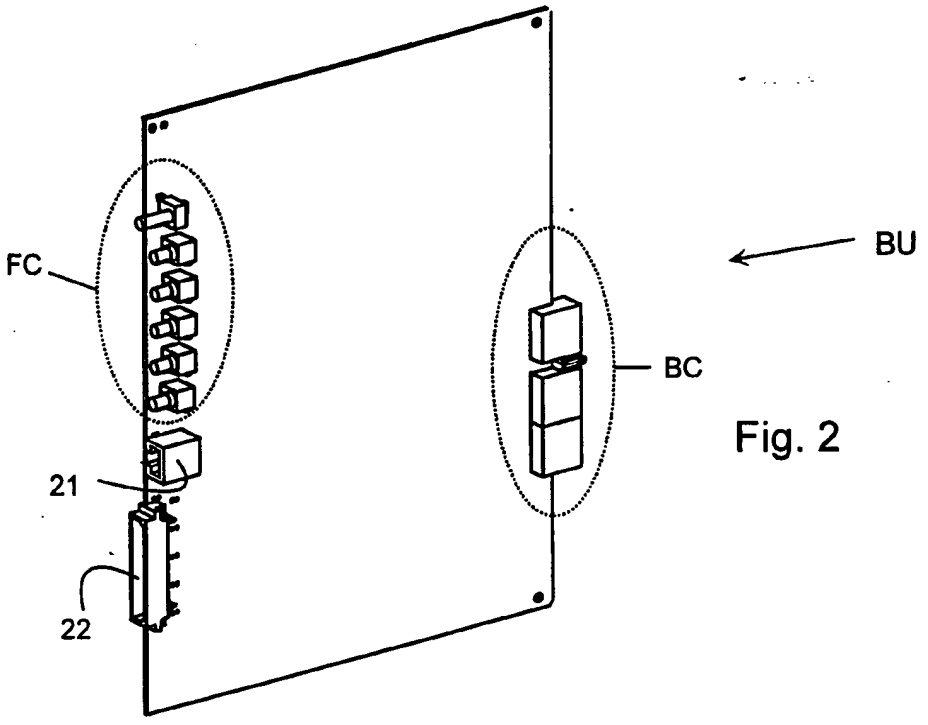

Fig. 2

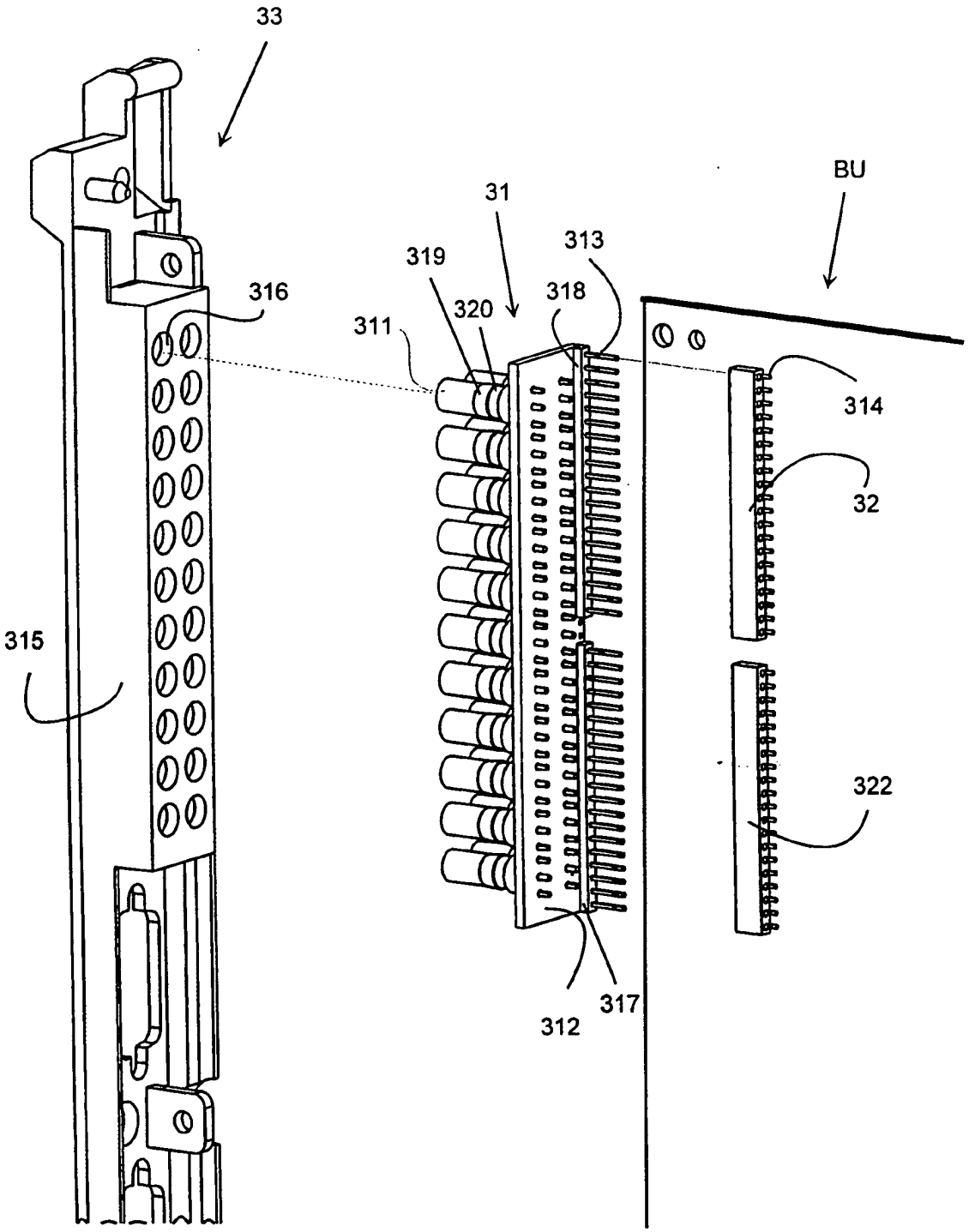

Fig. 3

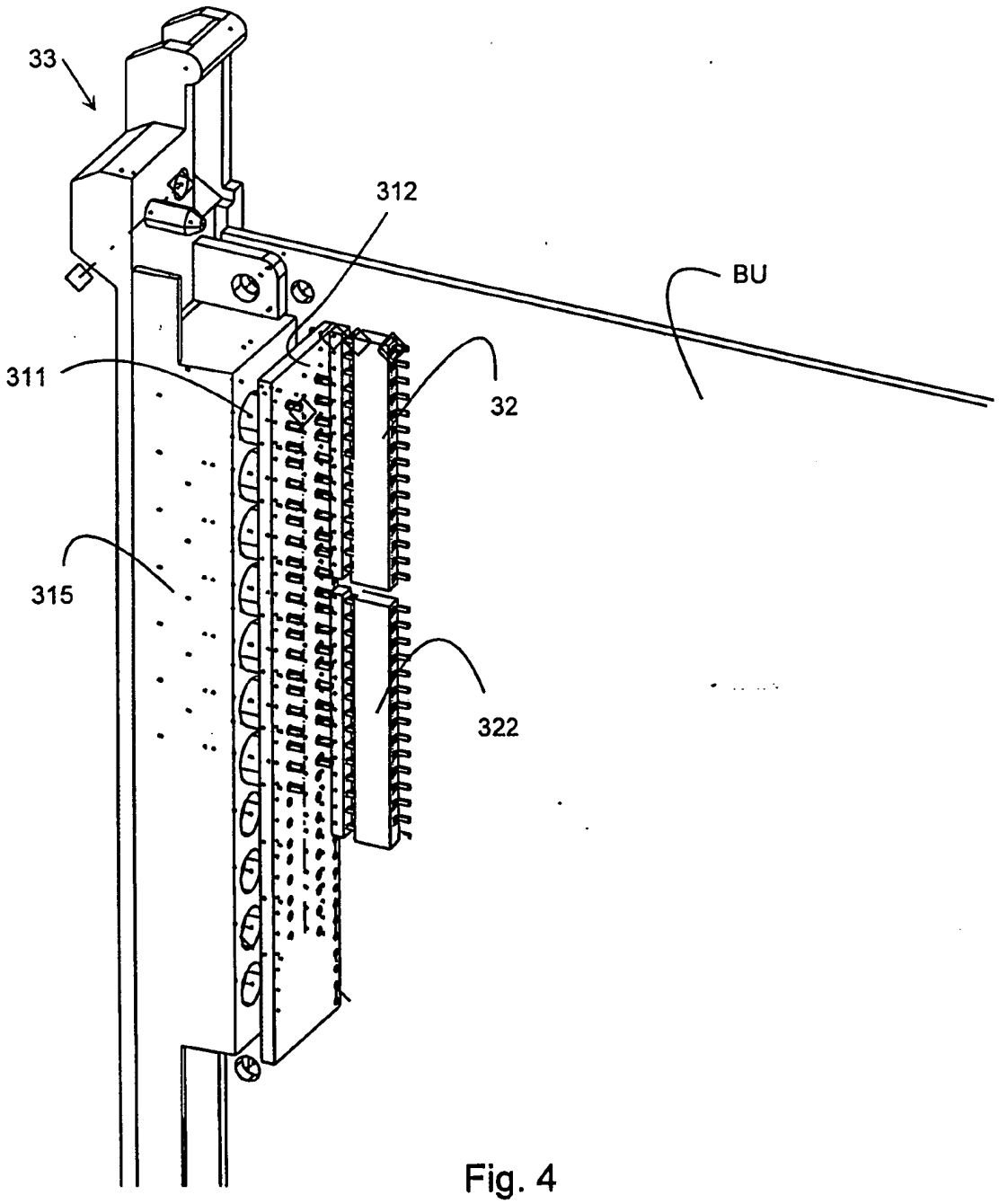

Fig. 4

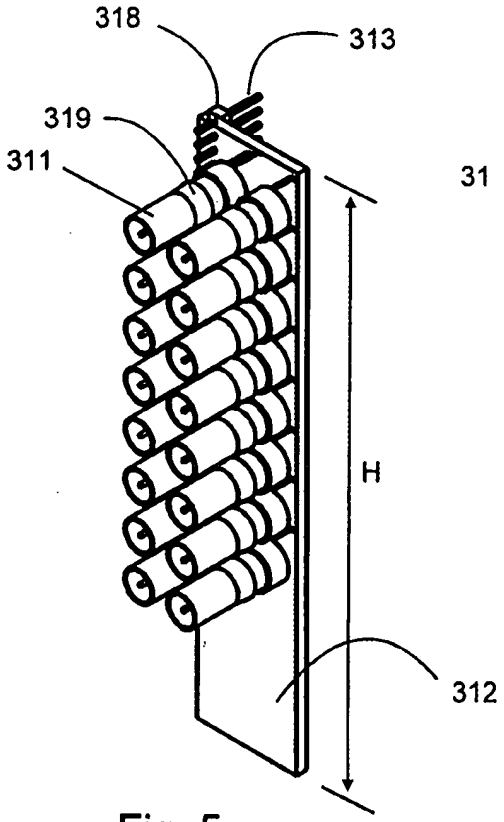

Fig. 5a

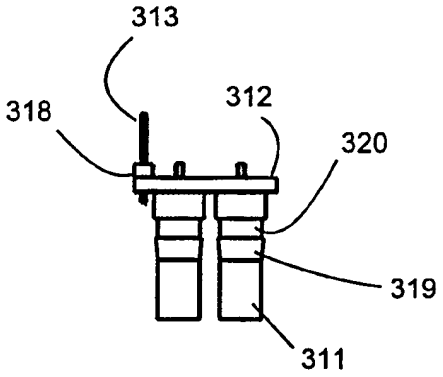

Fig. 5c

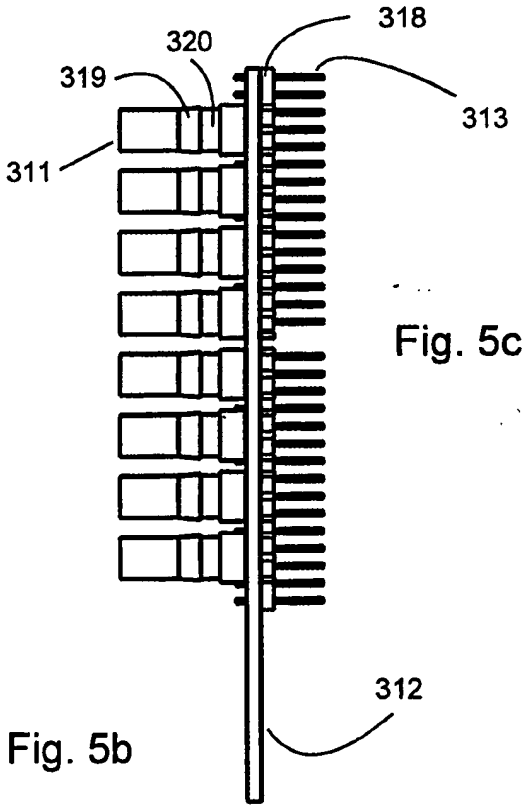

Fig. 5b

Fig. 5c

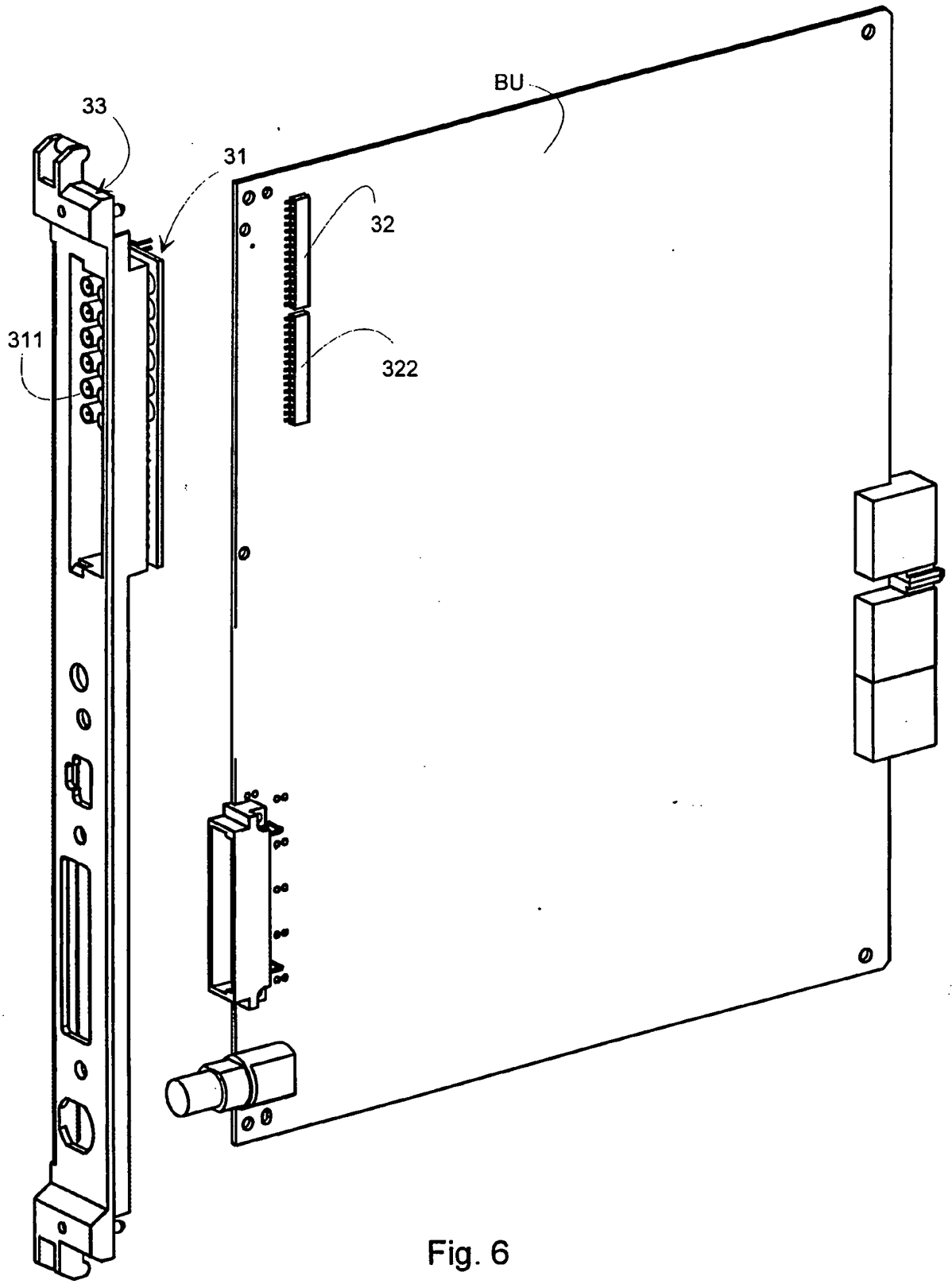

Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00046

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H01R 23/68, H01R 9/09, H05K 1/11
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3676746 A (G. KASSABGI ET AL), 11 July 1972 (11.07.72), column 3, line 48 - column 4, line 16, figures 1,2 --	1,2,5
A	US 5040993 A (E.M. KRUG ET AL), 20 August 1991 (20.08.91), column 3, line 6 - column 4, line 51, figures 1,2 --	1,2,6
A	GB 2092839 A (INTERNATIONAL COMPUTERS LIMITED), 18 August 1982 (18.08.82) --	1-3
A	JP 7142107 A (KITANI DENKI KK), 2 June 1995 (02.06.95) --	1,2

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
6 April 1998	08 -04- 1998
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00046

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